

PATENT COOPERATION TREATY
PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 07 FEB 2006

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Applicant's or agent's file reference GRM:AL:FP20449	FOR FURTHER ACTION		See Form PCT/IPEA/416
International application No. PCT/AU2004/001339	International filing date (day/month/year) 29 September 2004	Priority date (day/month/year) 30 September 2003	
International Patent Classification (IPC) or national classification and IPC Int. Cl. F02C 3/24 (2006.01) F02C 3/22 (2006.01) F01K 23/10 (2006.01) F02C 7/22 (2006.01)			
Applicant BHP BILLITON INNOVATION PTY LTD et al			

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
 - a. ☒ (sent to the applicant and to the International Bureau) a total of 20 sheets, as follows:
 - ☒ sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
 - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
 - b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or table related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items: .

- | | | |
|-------------------------------------|--------------|---|
| <input checked="" type="checkbox"/> | Box No. I | Basis of the report |
| <input type="checkbox"/> | Box No. II | Priority |
| <input type="checkbox"/> | Box No. III | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability |
| <input type="checkbox"/> | Box No. IV | Lack of unity of invention |
| <input checked="" type="checkbox"/> | Box No. V | Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| <input type="checkbox"/> | Box No. VI | Certain documents cited |
| <input type="checkbox"/> | Box No. VII | Certain defects in the international application |
| <input type="checkbox"/> | Box No. VIII | Certain observations on the international application |

Date of submission of the demand 2 May 2005	Date of completion of this report 27 January 2006
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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/AU2004/001339

Box No. I Basis of the report

1. With regard to the language, this report is based on:

- ☒ The international application in the language in which it was filed
☐ A translation of the international application into translation furnished for the purposes of:

☐ international search (under Rules 12.3(a) and 23.1 (b))

☐ publication of the international application (under Rule 12.4(a))

☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the elements of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

☐ the international application as originally filed/furnished

☒ the description:

pages as originally filed/furnished

pages* 1-13 received by this Authority on 9 December 2005 with the letter of 9 December 2005

pages* received by this Authority on with the letter of

☒ the claims:

pages as originally filed/furnished

pages* as amended (together with any statement) under Article 19

pages* 14-19 received by this Authority on 9 December 2005 with the letter of 9 December 2005

pages* received by this Authority on with the letter of

☒ the drawings:

pages 1/1 as originally filed/furnished

pages* received by this Authority on with the letter of

pages* received by this Authority on with the letter of

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages

☐ the claims, Nos.

☐ the drawings, sheets/figs

☐ the sequence listing (specify):

☐ any table(s) related to the sequence listing (specify):

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

☐ the description, pages

☐ the claims, Nos.

☐ the drawings, sheets/figs

☐ the sequence listing (specify):

☐ any table(s) related to the sequence listing (specify):

* If item 4 applies, some or all of those sheets may be marked "superseded."

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/AU2004/001339

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 1-16	YES
	Claims	NO
Inventive step (IS)	Claims 1-15	YES
	Claims 16	NO
Industrial applicability (IA)	Claims 1-16	YES
	Claims	NO

2. Citations and explanations (Rule 70.7)

The following documents identified in the International Search Report have been considered for the purposes of this report:

D1 : CA 2465384A1

D2 : US 6170264B1

New Citations

D3 : US 4488398A (NOGUCHI) 18 December 1984

D4 : US 5979183A (SMITH et al) 9 November 1999

Novelty (N)

None of the cited documents disclose all of the features of each of the independent claims. Therefore all of the claims are novel.

Inventive Step (IS)

Claim 16

D1 discloses a method of, and an apparatus for, generating power. See the features such as the gas turbine (13), the heat recovery boiler (21), the steam turbine (22) and the combustor (12). The combustor (12) receives oxygen, coal bed methane (6), and part of recovered flue gas through the condenser (15) and the compressor (11), while the other part is being deposited underground through compressor (4) and the gas feed pipe (5).

D2 in the embodiment shown in Figure 14 and the schematic shown in figure 18 disclose the features of the claimed invention. See, for example, the gas turbine (760), the HRSG (774), the steam turbine (786), the combustor (750). The combustor (750) receives oxygen from air separation plat (730), fuel (740), and part of recovered flue gas through the compressor (777) and the line (779), the other part being the excess outlet (778). Column 11, line 1 envisages methane as a possible fuel while column 2, lines 55-65 mention coal seams as possible underground storage sites for excess CO₂.

D3 and D4 individually teach supplying air from gas turbine air compressors to oxygen separation plants.

Thus D1 or D2, in alternate combination with either D3 or D4, such a combination being obvious to a person skilled in the art, render the subject matter of the above claim lacking an inventive step over the cited art.

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POWER GENERATION

5 The present invention relates to a method and an apparatus for generating electrical power that is based on the use of coal bed methane gas as a source of energy for driving a gas turbine and a steam turbine for generating the power.

10 The term "coal bed methane" is understood herein to mean gas that contains at least 75% methane gas on a volume basis obtained from an underground coal source.

15 According to the present invention there is provided a method of generating power via a gas turbine and a steam turbine which comprises:

(A) operating in a first mode by:

20 (a) supplying coal bed methane, an oxygen-containing gas, and flue gas produced in the gas turbine, all under pressure, to a combustor of the gas turbine and combusting the coal bed methane and using the heated combustion products and the flue gas to drive the gas turbine;

30 (b) supplying a hot flue gas stream produced in the gas turbine to a heat recovery steam generator and using the heat of the flue gas to generate steam by way of heat exchange with water supplied to the steam generator;

35 (c) supplying steam from the steam generator to a steam turbine and using the steam to drive the steam turbine; and

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(d) supplying (i) a part of the flue gas stream from the gas turbine that passes through the heat recovery steam generator to the combustor of the gas turbine and (ii) another part of the flue gas stream from the gas turbine that passes through the heat recovery steam generator to a suitable underground storage region;

and

(B) operating in a second mode by:

(a) supplying coal bed methane and air from an air compressor of the gas turbine, both under pressure, to a combustor of the gas turbine and combusting the coal bed methane and using the heated combustion products and the flue gas to drive the gas turbine;

(b) supplying a hot flue gas stream produced in the gas turbine to a heat recovery steam generator and using the heat of the flue gas to generate steam by way of heat exchange with water supplied to the steam generator;

(c) supplying steam from the steam generator to a steam turbine and using the steam to drive the steam turbine.

One of the features of the method and the apparatus of the present invention is that it can operate with no CO₂ emissions into the atmosphere.

By way of example, supplying all of the flue gas, which inevitably contains substantial amounts of CO₂, that

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is not supplied to the combustor of the gas turbine to the suitable underground storage in operating mode (A) is an effective option for preventing CO₂ emissions into the atmosphere that does not have any adverse environmental consequences.

Another feature of the present invention is that the use of part of the flue gas stream from the gas turbine in the combustor of the gas turbine in operating mode (A) makes it possible to reduce, and preferably replace altogether, the use of air in the combustor of the gas turbine. The total replacement of air with oxygen and flue gas, which is predominantly CO₂ in this mode of operation, overcomes significant issues in relation to the use of air. For example, the use of air means that the flue gas stream from the gas turbine contains a significant amount (typically at least 70 vol.%) nitrogen, an amount (typically 10 vol.%) oxygen, and an amount (typically 5-10 vol.%) CO₂. The mixture of nitrogen, oxygen, and CO₂ presents significant gas separation issues in order to process the flue gas stream properly. The replacement of air with oxygen and flue gas in this mode of operation means that the flue gas stream from the heat recovery steam generator is predominantly CO₂ and water and greatly simplifies the processing requirements for the flue gas from the gas turbine, with the result that it is a comparatively straightforward exercise to produce a predominately CO₂ flue gas stream and supply the stream to the combustor of the gas turbine.

Preferably the oxygen-containing gas supplied to the combustor of the gas turbine in operating mode (A) is oxygen.

Preferably the flue gas stream supplied to the combustor of the gas turbine in operating mode (A) is predominantly CO₂.

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Preferably step (d) of operating mode (A) includes supplying part of the flue gas stream to the combustor of the gas turbine and the remainder of the flue gas stream to the underground storage.

Preferably step (d) of operating mode (A) includes supplying the flue gas stream to the underground storage region as a liquid phase.

Preferably the underground storage region is a coal bed seam.

More preferably the underground storage region is the coal bed seam from which coal bed methane to power the gas turbine is extracted. In this context, the existing well structures for extracting coal bed methane can be used to transfer flue gas, in liquid or gas phases, to the underground storage region.

Preferably step (d) of operating mode (A) includes supplying the flue gas stream to the underground storage region via existing well structures for extracting coal bed methane from the underground storage region.

Preferably step (d) of operating mode (A) includes separating water from the flue gas.

Step (d) of operating mode (A) may further include:

(i) compressing the flue gas stream to a first pressure (typically 20-30 bar); and

(ii) supplying one part of the compressed flue gas stream to the combustor of the gas turbine.

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Step (d) of operating mode (A) may further include:

- 5 (i) compressing another part of the compressed flue gas stream to a second, higher pressure (typically at least 70 bar, more typically at least 73 bar);
- 10 (ii) cooling the pressurised flue gas stream from step (i) and forming a liquid phase; and
- 15 (iii) supplying the liquid phase to the underground storage region.

The method may also include supplying air from the air compressor of the gas turbine and producing oxygen in the plant during operating mode (A).

20

According to the present invention there is also provided an apparatus for generating power via a gas turbine and a steam turbine which comprises:

- 25 (a) a gas turbine having an air compressor, an air expander, and a combustor;
- (b) an air separation plant for producing oxygen;
- 30 (c) means for supplying the following feed materials to the combustor of the gas turbine: coal bed methane, oxygen from the air separation plant, air from the air compressor of the gas turbine, and flue gas produced in the gas turbine, all under pressure, for combusting the coal bed
- 35

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methane and using the heated combustion products and the flue gas to drive the gas turbine;

- 5 (d) a heat recovery steam generator for generating steam from water supplied to the steam generator by way of heat exchange with a flue gas from the gas turbine;
- 10 (e) a steam turbine adapted to be driven by steam generated in the steam generator; and
- 15 (f) a means for supplying (i) one part of a flue gas stream from the gas turbine that passes through the heat recovery steam generator to the combustor of the gas turbine and (ii) another part of the flue gas stream from the gas turbine that passes through the heat recovery steam generator to a suitable underground storage region when the apparatus is operating with coal bed methane, oxygen from the air separation plant, and flue gas produced in the gas turbine being supplied to the combustor of the gas turbine.
- 20
- 25

Preferably the means for supplying one part of the flue gas stream to the combustor of the gas turbine and another part of the flue gas stream to the suitable underground storage region includes a means for converting the flue gas from a gas phase into a liquid phase to be supplied to the suitable underground storage region.

30

Preferably the apparatus includes a means for supplying air from the air compressor of the gas turbine to the air separation plant as a source of oxygen.

35

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According to the present invention there is also provided a method of generating power via a gas turbine and a steam turbine which comprises:

- 5 (a) supplying compressed air from an air compressor of the gas turbine to an oxygen plant and producing oxygen gas;
- 10 (b) supplying coal bed methane, oxygen from the oxygen plant, and flue gas which is predominantly CO₂ produced in the gas turbine, all under pressure, to a combustor of the gas turbine and combusting the coal bed methane and using the heated combustion products and the flue gas to drive the gas turbine;
- 15 (c) supplying a hot flue gas stream produced in the gas turbine to a heat recovery steam generator and using the heat of the flue gas to generate steam by way of heat exchange with water supplied to the steam generator;
- 20 (d) supplying steam from the steam generator to a steam turbine and using the steam to drive the steam turbine; and
- 25 (e) supplying (i) a part of the flue gas stream from the gas turbine that passes through the heat recovery steam generator to the combustor of the gas turbine and (ii) another part of the flue gas stream from the gas turbine that passes through the heat recovery steam generator to a suitable underground storage region.
- 30
- 35

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The present invention is described further with reference to the accompanying drawing which is one, although not the only, embodiment of a power generation method and apparatus of the invention.

With reference to the figure, the method includes supplying the following gas streams to a combustor 5 of a gas turbine generally identified by the numeral 7:

- (a) coal bed methane from an underground source 3 via a dedicated coal bed methane compressor station (not shown) and a supply line 51;
- (b) oxygen, in an amount required for stoichiometric combustion, produced in an oxygen plant in the form of an air separation plant 11, via a line 53;
- (c) flue gas, which is predominantly CO₂, that has been supplied from a flue gas stream from the turbine 7, described hereinafter, via a line 55.

The streams of oxygen and flue gas are pre-mixed in a mixer 9 upstream of the combustor 5.

The streams of coal bed methane and oxygen/flue gas are supplied to the combustor 5 at a preselected pressure of between 16 and 28 bar. It is noted that the combustor may operate with any suitable pressure.

The coal bed methane is combusted in the combustor 5 and the products of combustion and the flue gas are delivered to an expander 13 of the turbine 7 and drive the turbine blades (not shown) located in the expander 13.

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The output of the turbine 7 is connected to and drives an electrical generator 15 and a multiple stage flue gas compressor train 17.

5

When the power generation method is operating in this mode, air in the air compressor 21 of the turbine 7 is bled at approximately 5 bar pressure and delivered to the air separation plant and is used to produce oxygen for the combustor 5 of the gas turbine 7.

10

The output gas stream, ie the flue gas, from the turbine 7 is at atmospheric pressure and typically at a temperature of the order of 540°C.

15

The flue gas from the turbine 7 is passed through a heat recovery steam generator 27 and is used as a heat source for producing high pressure steam, typically approximately 75 bar or 7.5 Mpa, from demineralised water and condensate return supplied to the steam generator 27.

20

The high pressure steam is supplied via a line 57 to a steam turbogenerator 29 and is used to run the turbogenerator 29 and generate electrical power.

25

The flue gas from the heat recovery steam generator 27, which is predominantly CO₂ and water, leaves the steam generator as a wet flue gas stream, typically at a temperature of 125°C, via an outlet 19.

30

The wet flue gas is then passed through a water separator 33 that separates water from the stream and produces a dry flue gas stream.

35

The dry flue gas stream is then passed through the multiple stage flue gas compressor train 17.

- 10 -

In a first stage of compression the flue gas is compressed to the necessary pressure, namely 22 bar in the present instance, for the combustor 5 of the turbine 7.

5 Compressed flue gas from the exit of the first stage is supplied to the combustor 5 of the turbine 7 via the mixer 9, typically a mix valve, and mixes with oxygen from the air separator 11 prior to being supplied to the combustor 5.

10 The remainder of the flue gas is supplied to the second compression stage, marked "Stage 2" in the figure, and is compressed to a high pressure, typically above 73 bar, and the stream of compressed flue gas is then passed
15 through a condenser 35. The condenser 35 cools the temperature of the flue gas stream to below 31°C and thereby converts the flue gas to a liquid phase.

20 The liquid flue gas stream leaving the condenser is pressurised (if necessary) and then injected into existing field wells.

25 When the power generation system is not operating in the above-described mode and, more particularly is not receiving the stream of pre-mixed oxygen and flue gas, the turbine 7 operates on a conventional basis with air being drawn through the turbine air intake (not shown) and compressed in the air compressor 21 and thereafter delivered to the combustor 5 and mixed with coal bed
30 methane and the mixture combusted in the combustor 5.

35 More particularly, the option of operating on a more conventional basis is available by disconnecting the multiple stage flue gas compressor train 17 from the turbine 7.

The key components of the above-described

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embodiment of the process and the apparatus of the invention shown in the figure are as follows:

- 5 (a) Air Separation Plant - This unit is required to produce oxygen for combustion of coal bed methane in the turbine combustor. Typically, the plant is a standard off-the-shelf unit sized to cope with the O₂ required for complete
10 combustion of coal bed methane.
- 15 (b) Gas Turbine/Generator - Typically, this unit is a standard gas turbine fitted with a standard combustor. The multi-stage flue gas compressor will be fitted on the same shaft with a clutch unit that will enable the compressor to be isolated when the turbine is operating in a conventional
20 manner. The attachment of large multi-stage compressors to gas turbine units is quite common in the steel industry where low Btu steelworks gases are compressed by these units before being delivered to the combustor for combustion.
- 25 (c) Heat Recovery Steam Generator - Typically, this unit is a standard double pressure unfired unit.
- 30 (d) Steam Turbine/Generator - Typically, this unit, complete with the steam cycle ancillaries, is a standard steam turbine unit.
- 35 (e) Flue Gas Recirculating and CO₂ Underground storage System - Typically, this system contains the following:

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- 5 (i) Water Separator/knockout Unit -
Typically this unit is a simple
water separation plant in which
water is knocked out of the flue
gas stream prior it entering the
multi-stage compressor unit.
- 10 (ii) CO₂ multi-stage compressor train -
For the embodiment shown in Figure
1, typically this unit is designed
to handle the entire flue gas
stream in the first stage of
compression and the smaller stream
15 of flue gas for underground storage.
This smaller stream will be
pressurised to above 73 bar before
being delivered to the condenser.
- 20 (iii) Condenser - This unit is required
to produce liquid flue gas, which
is predominantly CO₂, prior to
injecting it to underground wells.

25 Many modifications may be made to the embodiments
of the present invention described above without departing
from the spirit and scope of the invention.

30 By way of example, in another, although not the
only other possible, embodiment of the method and the
apparatus of the invention, the flue gas from the steam
generator 27 is passed through a recuperator and is cooled
to a temperature, typically 80C, before being transferred
to the water separator 33. In addition, the dry flue gas
35 is not split into two streams after the first stage in the
multiple stage flue gas compressor train 17, as is the
case in the embodiment shown in the figure. Rather, the

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whole of the dry flue gas from the water separator 33 is compressed in the compressor train 17 and then passed through the condenser 35. The liquid stream from the condenser 35 is then split into two streams, with one
5 stream being supplied to the underground storage region and the other stream being passed through the recuperator 31 and being converted into a gas phase via heat exchange with the flue gas stream from the steam generator 27. The reformed flue gas from the recuperator 31 is then supplied
10 to the combustor 5 via the mixer 9.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method of generating power via a gas turbine and a steam turbine which comprises:

(A) operating in a first mode by:

(a) supplying coal bed methane, an oxygen-containing gas, and flue gas produced in the gas turbine, all under pressure, to a combustor of the gas turbine and combusting the coal bed methane and using the heated combustion products and the flue gas to drive the gas turbine;

(b) supplying a hot flue gas stream produced in the gas turbine to a heat recovery steam generator and using the heat of the flue gas to generate steam by way of heat exchange with water supplied to the steam generator;

(c) supplying steam from the steam generator to a steam turbine and using the steam to drive the steam turbine; and

(d) supplying (i) a part of the flue gas stream from the gas turbine that passes through the heat recovery steam generator to the combustor of the gas turbine and (ii) another part of the flue gas stream from the gas turbine that passes through the heat recovery steam generator to a suitable underground storage region;

and

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(B) operating in a second mode by:

- 5 (a) supplying coal bed methane and air from an air compressor of the gas turbine, both under pressure, to a combustor of the gas turbine and combusting the coal bed methane and using the heated combustion products and the flue gas to drive the gas turbine;
- 10 (b) supplying a hot flue gas stream produced in the gas turbine to a heat recovery steam generator and using the heat of the flue gas to generate steam by way of heat exchange with water supplied to the steam generator;
- 15 (c) supplying steam from the steam generator to a steam turbine and using the steam to drive the steam turbine.
- 20 2. The method defined in claim 1 wherein the oxygen-containing gas supplied to the combustor of the gas turbine in operating mode (A) is oxygen.
- 25 3. The method defined in claim 1 or claim 2 wherein the flue gas stream supplied to the combustor of the gas turbine in operating mode (A) is predominantly CO₂.
- 30 4. The method defined in any one of the preceding claims wherein step (d) of operating mode (A) includes supplying part of the CO₂-containing flue gas stream to the combustor of the gas turbine and the remainder of the flue gas stream to the underground storage.
- 35 5. The method defined in any one of the preceding claims wherein step (d) of operating mode (A) includes supplying the flue gas stream to the underground storage

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region as a liquid phase.

6. The method defined in any one of the preceding claims wherein the underground storage region is a coal bed seam.

7. The method defined in claim 6 wherein the underground storage region is the coal bed seam from which coal bed methane to power the gas turbine is extracted.

8. The method defined in claim 7 wherein step (d) includes supplying the flue gas stream to the underground storage region via existing well structures for extracting coal bed methane from the underground storage region.

9. The method defined in any one of the preceding claims wherein step (d) of operating mode (A) includes separating water from the flue gas.

10. The method defined in any one of the preceding claims wherein step (d) of operating mode (A) includes:

(i) compressing the flue gas stream to a first pressure (typically 20-30 bar); and

(ii) supplying one part of the compressed flue gas stream to the combustor of the gas turbine.

11. The method defined in claim 10 wherein step (d) of operating mode (A) further includes:

(i) compressing another part of the compressed flue gas stream to a second, higher pressure (typically at least 70 bar, more typically at least 73 bar);

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(ii) cooling the pressurised flue gas stream
from step (i) and forming a liquid phase;
and

5 (iii) supplying the liquid phase to the
underground storage region.

12. The method defined in any one of the preceding
claims includes supplying air from the air compressor of
10 the gas turbine and producing oxygen in the plant during
operating mode A.

13. An apparatus for generating power via a gas
turbine and a steam turbine which comprises:

- 15 (a) a gas turbine having an air compressor, an
expander, and a combustor;
- (b) an air separation plant for producing
20 oxygen;
- (c) [a] means for supplying the following feed
materials to the combustor of the gas
turbine: coal bed methane, oxygen from the
25 air separation plant, air from the air
compressor of the gas turbine, [an oxygen-
containing gas,] and flue gas produced in
the gas turbine, all under pressure, [to a
combustor of the gas turbine] for
30 combusting the coal bed methane and using
the heated combustion products and the flue
gas to drive the gas turbine;
- (d) a heat recovery steam generator for
35 generating steam from water supplied to the
steam generator by way of heat exchange
with a flue gas from the gas turbine;

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(e) a steam turbine adapted to be driven by steam generated in the steam generator; and

5 (f) a means for supplying (i) one part of a flue gas stream from the gas turbine that passes through the heat recovery steam generator to the combustor of the gas turbine and (ii) another part of the flue gas stream from the gas turbine that passes
10 through the heat recovery steam generator to a suitable underground storage region, when the apparatus is operating with coal bed methane, oxygen from the air separation plant, and flue gas produced in the gas
15 turbine being supplied to the combustor of the gas turbine.

14. The apparatus defined in claim 12 wherein the means for supplying one part of the flue gas stream to the
20 combustor of the gas turbine and another part of the flue gas stream to the suitable underground storage region includes a means for converting the flue gas from a gas phase into a liquid phase to be supplied to the
underground storage region.

25 15. The apparatus defined in claim 13 or claim 14 includes a means for supplying air from the air compressor of the gas turbine to the air separation plant as a source of oxygen.

30 16. A method of generating power via a gas turbine and a steam turbine which comprises:

35 (e) supplying compressed air from an air compressor of the gas turbine to an oxygen plant and producing oxygen gas;

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- 5 (f) supplying coal bed methane, oxygen from the oxygen plant, and flue gas which is predominantly CO₂ produced in the gas turbine, all under pressure, to a combustor of the gas turbine and combusting the coal bed methane and using the heated combustion products and the flue gas to drive the gas turbine;
- 10 (g) supplying a hot flue gas stream produced in the gas turbine to a heat recovery steam generator and using the heat of the flue gas to generate steam by way of heat exchange with water supplied to the steam generator;
- 15 (h) supplying steam from the steam generator to a steam turbine and using the steam to drive the steam turbine; and
- 20 (e) supplying (i) a part of the flue gas stream from the gas turbine that passes through the heat recovery steam generator to the combustor of the gas turbine and (ii)
- 25 another part of the flue gas stream from the gas turbine that passes through the heat recovery steam generator to a suitable underground storage region.

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ABSTRACT

A method and apparatus for generating power via a gas turbine (7) and a steam turbine (29) is disclosed. Coal
5 bed methane, oxygen, and flue gas (predominately CO₂)
produced in the gas turbine, all under pressure, are
supplied to a combustor (5) of the gas turbine and operate
the turbine. A hot flue gas stream produced in the gas
turbine (predominately CO₂) is supplied to a heat recovery
10 steam generator (27) and the heat of the flue gas
generates steam. The steam is used to drive the steam
turbine. A part of the flue gas stream that passes
through the heat recovery steam generator is supplied to
the combustor of the gas turbine and another part of the
15 flue gas stream is supplied to a suitable underground
storage region.